

E 7 4 - 1 0 1 6 5
CR-136292

"Made available under NASA sponsorship
in the interest of early and wide dis-
semination of Earth Resources Survey
Program information and without liability
for any use made thereof."

DYNAMICS OF PLANKTON POPULATIONS
IN UPWELLING AREAS

Karl-Heinz Szekiolda
University of Delaware

(E74-10165) DYNAMICS OF PLANKTON
POPULATIONS IN UPWELLING AREAS (Delaware
Univ) 24 p HC \$3 25 CSCL 08A

N74-14033

Unclas
G3/13 00165

Contract No.: NAS 9-13344

July 1973

INTRODUCTION

For the Skylab missions, ground truth was established for a six month period. From April 9 to July 9, 1973, Fred K. Lepple participated in the cruise of Woods Hole's R/V "Atlantis II" (IDOE Program) off the Northwest Coast of Africa as part of the ground truth observations. During the two legs (February 11 to April 4) that no University of Delaware personnel were on shipboard, Dr. Walter Pople of the University of Ghana conducted the chlorophyll, temperature and airborne particulate measurements. Thus, data on these parameters is nearly complete over the six month research program.

METHODS

General

The actual cruise track is given in Figure 1 and this supercedes the projected transects included in the April 1973 project report. The apparatus and methods for the continuous fluorometry (chlorophyll a), sea surface temperature and airborne particulates are also described in the April report. In addition, sixty surface seawater samples were collected in regions of most frequent dustfalls. These samples were stored in a frozen condition and will be analyzed for silicate and phosphate. Coupled with our laboratory experiments on the reaction kinetics of the airborne dust, we will be able to estimate the chemical contribution of eolian material to the nutrient concentration in this area.

Preliminary Results

A) Sea surface temperature: This entire data set has been digitized and is presently being plotted and correlated with the chlorophyll values. The surface temperature values are also being compared to synoptic satellite data (NOAA-NESS) using a thermal infrared sensor. Using averaged temperature values for the satellite data over 1° of latitude and longitude squares, good agreement (generally within the 0.5°C resolution limit of the satellite measurements) was obtained for offshore areas. In nearshore regions, where sharp temperature gradients occur over short distances, the averaging technique for the 60 x 60 nautical mile squares

is not satisfactory and deviations between satellite data and shipboard measurements average ± 2 to 3°C . This difficulty will be overcome by requesting the nearshore data over smaller areas.

B) Chlorophyll: The chlorophyll *a* data has been contoured in Figure 2 in units of micrograms per liter or milligrams per cubic meter. The measurements were essentially continuous but are indicated here as 2-hour averages along the traverses. From about 25°N latitude to 30°N latitude, the high surface chlorophyll *a* values are confined to a narrow strip along the African coast as a result of coastal upwelling. South of 25°N latitude, this area widens, reaches a relative minimum width east of the Cape Verde Islands and then increases along the coast of Guinea. Although not shown in Figure 2 due to the scale of the chart, the highest chlorophyll *a* concentration (20.8 mg/m^3) was found close to the coast near Nouakchott, Mauritania while the upwelling area near Cape Blanc had values in the range of 10 to 18 mg/m^3 . From 10°N latitude to 5°S latitude only isolated patches or near coastal areas contained chlorophyll *a* values higher than 0.2 mg/m^3 . Some of these relatively higher values offshore were associated with sea mounts which provide a mechanism for diverting cooler nutrient-rich deeper waters to near-surface horizons. Temperature measurements also support the existence of these conditions.

Individual transects in the high productivity regions are being plotted in greater detail to aid in the interpretation of the upwelling processes and dynamics.

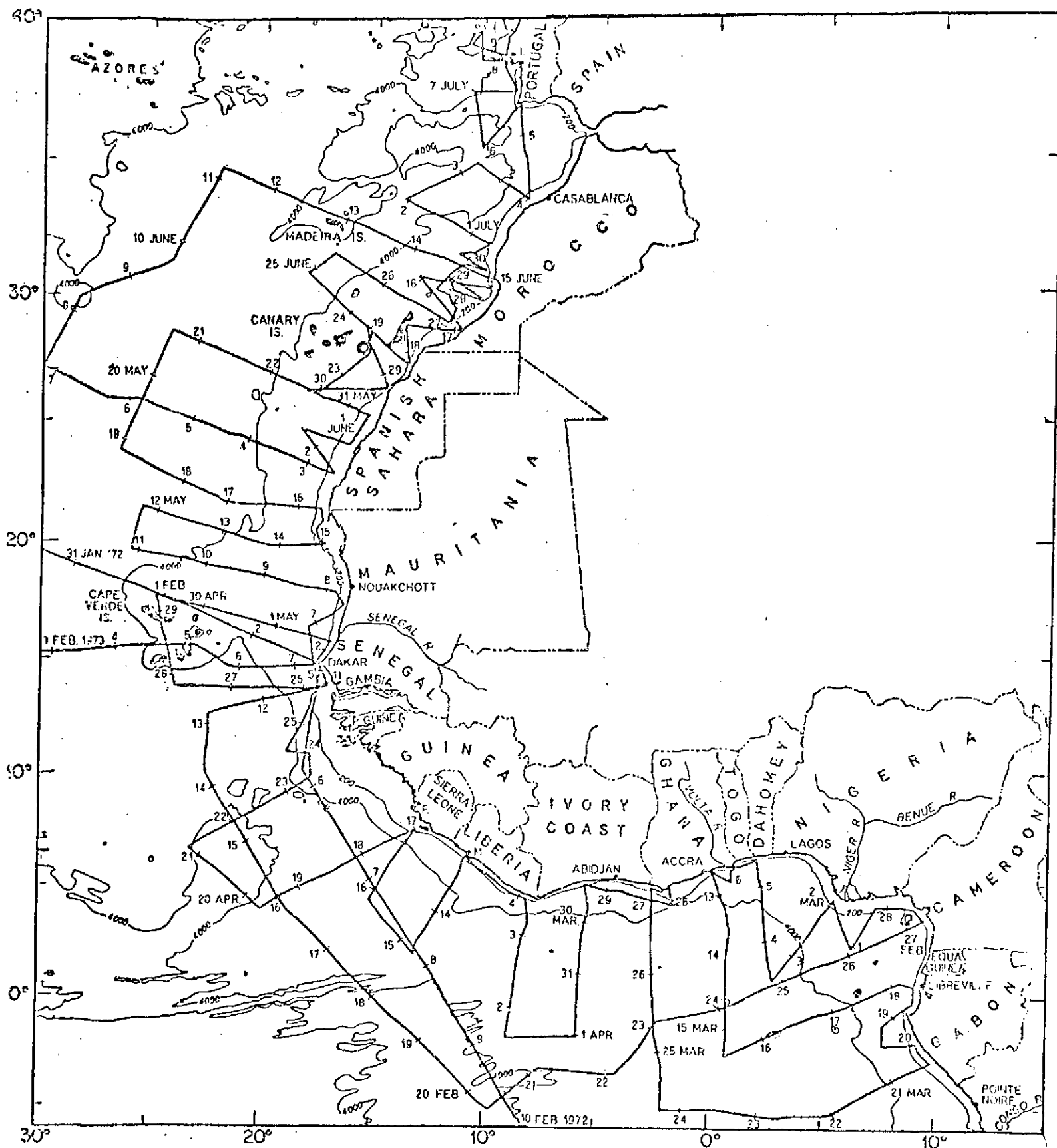
C) Atmospheric Particulates: During the entire cruise, 116 hi-vol sampling intervals and 81 Anderson cascade impactor (particle sizing devices) intervals were obtained. Preliminary total particulate loadings

are shown in Figure 3 in units of micrograms per cubic meter of air. Both soluble and insoluble airborne particulates were collected well forward on the ship at 10 meters above the ocean surface. The numbers of Figure 3 indicate the average concentrations along the part of a traverse between cross marks; circles around the numbers denote the presence of observable haze conditions. Color codings of the filters are included in the two appendices. In general, a grey color indicates the presence of sea salts and under unfavorable wind conditions, a grey or grey black color denotes stack effluent contamination. Beige and red-brown colors on the filters are indicative of wind-blown material from arid regions such as the Sahara Desert. Brown dust originates from semi-arid regions. Chemical and mineralogical analyses as well as soluble and insoluble separations will be performed on several representative samples collected on these filters and from sources on the North African continent.

Background concentrations for the soluble components (sea spray) in the open ocean under the influence of the persistent trade winds is approximately 10 to 20 micrograms per cubic meter. Although this concentration range will be a function of wind speed and fetch, it is evident from the total loading values that north of 32°N latitude, the insoluble loadings (dust) are low. This would be expected since the observed winds were generally north to northwesterly in this region. Further south to approximately 10°N latitude, loose surface deposits from arid regions were transported offshore by the Northeast Trade Winds. A heavy dustfall occurred on May 5 and 6 in which the loadings averaged almost 1000 micrograms per cubic meter of air. Satellite photos of this

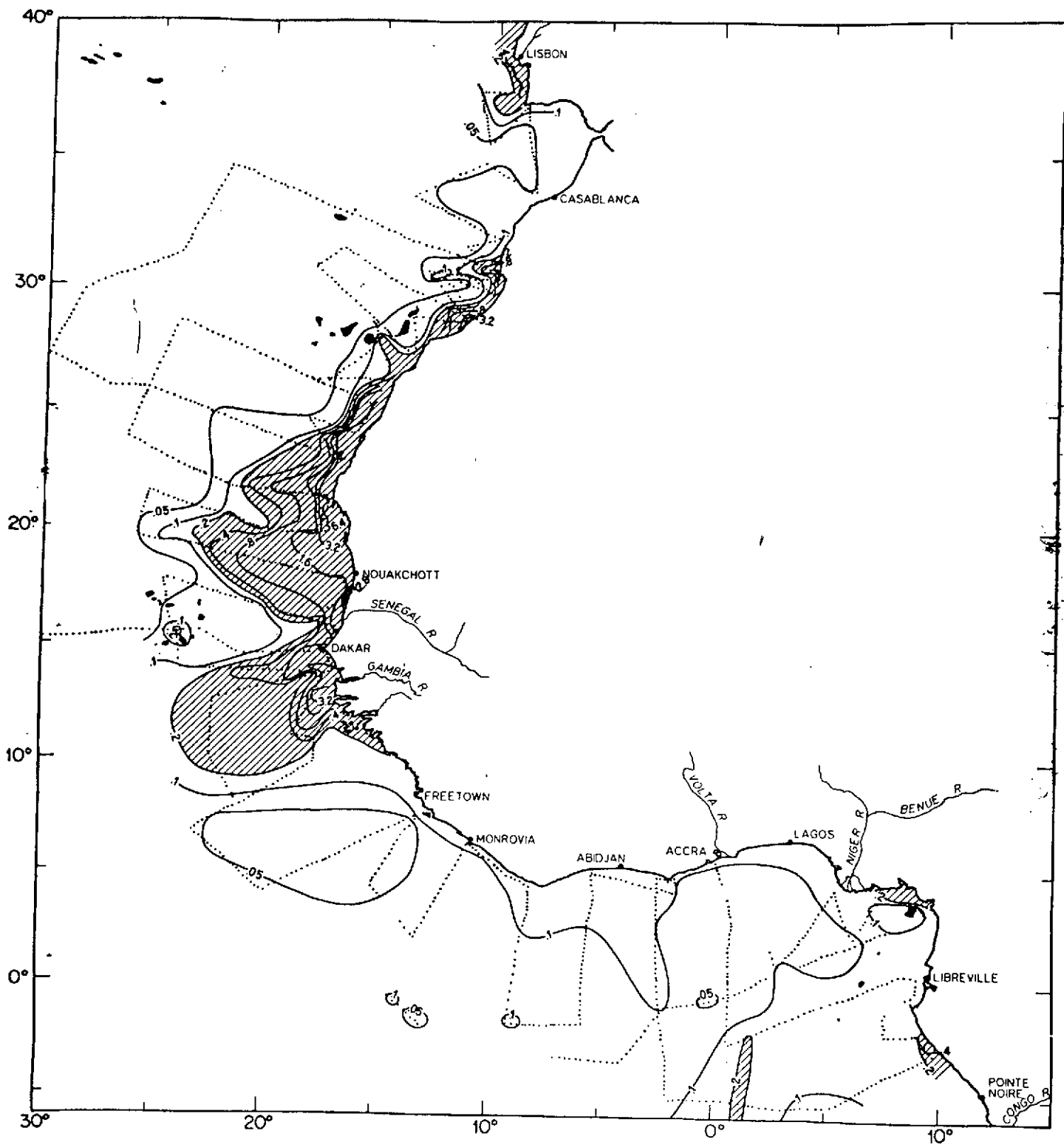
area often show the paths of these dust storms as they travel across the Atlantic Ocean. Below 5°N latitude, the southerly winds do not generally transport much terrestrial material but in the months of February and March, moderately high values were measured. Harmattan winds from the North were the source of the high levels of brown dust measured in the region South of Accra, Ghana.

Fig. 1



Cruise track of R/V ATLANTIS II

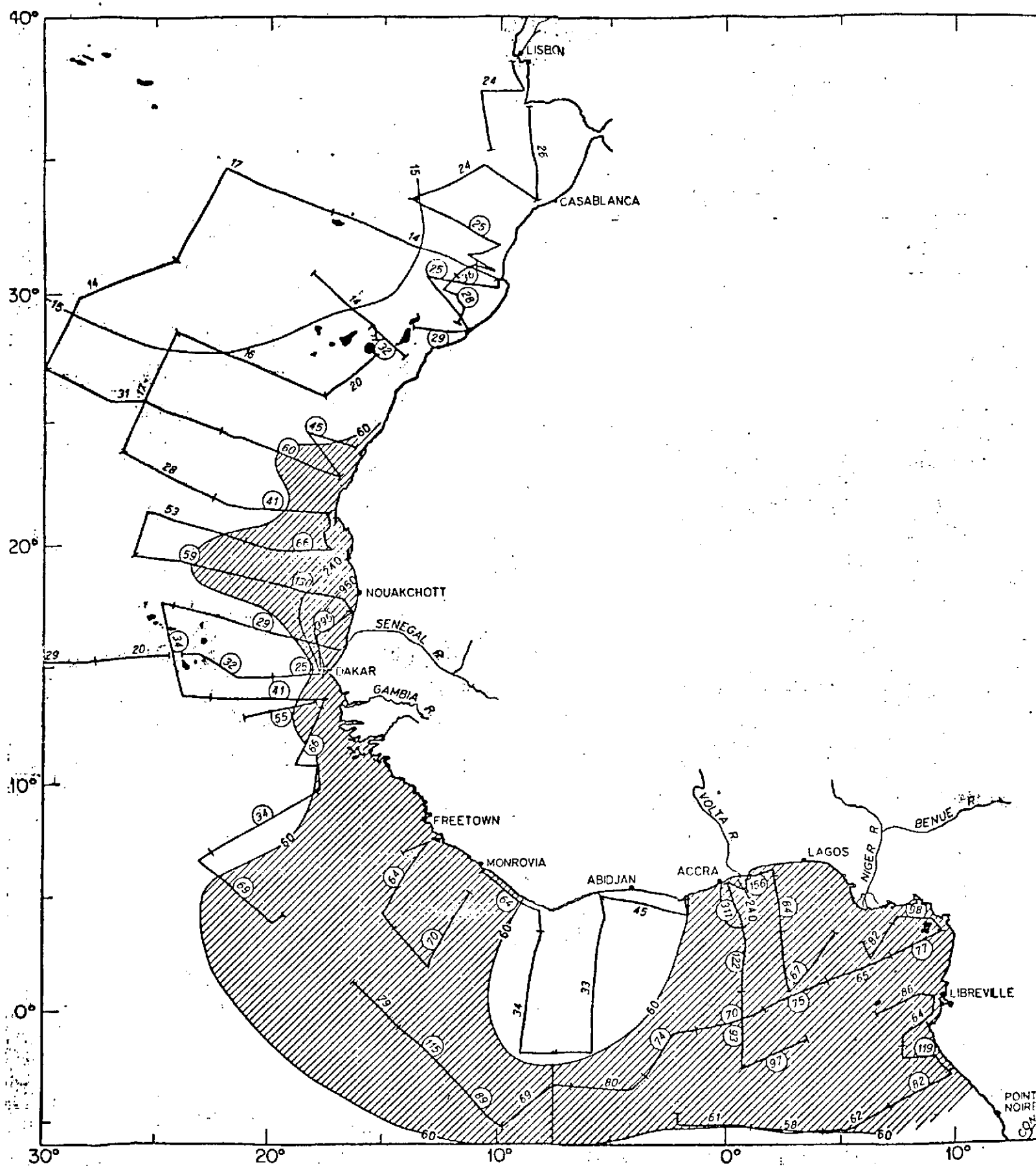
Fig. 2



Surface Chlorophyll a contours in micrograms/liter

Fig. 3

Total airborne particulate concentrations in micrograms/cubic meter of air



APPENDIX I

Airborne Particulate Sampling Program

Anderson Sampler Results: Filter Color

R/V ATLANTIS II

Legs I through VII

Jan. 20, 1973 to July 7, 1973

Explanation of Tables:

Exposure Number refers to consecutive sampling intervals based on high-volume sampler designations on chart.

Dates and Times are given in Greenwich Time for the start and finish of sampling period.

Cumulative Hours refers to actual sampling time during the sampling interval. This term takes into account the sampling time lost due to filter changes or sampler shut-down during unfavorable conditions.

Filter Color is a visual color evaluation: (l) = light; (vl) = very light loading; (m) = medium; (h) = heavy loading.

Filter Fractions: P1 refers to top collector plate containing particles of size greater than 7 microns diameter, P2 includes particle sizes between 7 and 3.3 microns, P3 includes particles between 3.3 and 2.0 microns, P4 includes particles between 2.0 and 1.1 microns, and GF includes particles between 1.1 and 0.01 microns.

Leg I - Woods Hole to Dakar

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
1	1/25(1300)-1/27(1300)	48.0	(not viz)	(not viz)	(not viz)	(not viz)	(barely viz)
4	1/31(1830)-2/1(1900)	24.5	beige (v1)	beige (1)	beige (1)	beige	grey (1)
6	2/3(1515)-2/4(1545)	24.5	(not viz)	(not viz)	beige (1)	beige (v1)	grey (v1)
7	2/4(1845)-2/6(1200)	41.8	brown (v1)	beige (v1)	beige (v1)	grey	grey (v1)

Leg II - Dakar to Tema

9	2/11(1000)-2/12(0945)	23.8	beige (v1)	beige (1)	beige-grey	grey (1)	grey (v1)
10	2/12(1050)-2/13(0930)	22.7	brown (v1)	brown	brown	brown	grey (m)
11	2/13(1445)-2/15(0950)	36.4	grey-brown(1)	brown	brown	grey-brown	grey (1)
12	2/15(1650)-2/17(0830)	31.7	brown	beige	beige	brown	grey (m)
13	2/17(0900)-2/18(0815)	23.3	beige (v1)	beige	beige	grey-beige	grey (1)
14	2/18(0900)-2/19(0810)	23.2	brown (v1)	brown	brown	grey-brown	grey (m)
15	2/19(0845)-2/20(0800)	23.3	(barely viz)	beige	beige	grey-beige	grey (1)
16	2/20(0835)-2/21(0830)	24.0	(barely viz)	beige	beige	grey-beige	grey (1)
17	2/21(0900)-2/22(0810)	23.2	beige (v1)	beige	beige	grey-beige	grey (1)

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
18	2/22(0850)-2/23(0810)	23.3	beige (v1)	beige	beige	grey-beige	grey (m)
19	2/23(0840)-2/24(0800)	23.3	beige (1)	beige (1)	beige (1)	grey-beige	grey (1)
20	2/24(0900)-2/25(0820)	23.3	brown	beige (1)	beige (1)	grey (m)	grey (1)
21	2/25(0900)-2/26(0820)	23.3	(barely viz)	beige (v1)	beige (v1)	grey (m)	grey (1)
22	2/26(0930)-2/27(0800)	22.5	beige (v1)	beige	beige	grey-beige	grey (m)
23	2/27(0830)-2/28(0815)	23.8	beige (v1)	beige	beige	brown	grey (m)
24	2/28(0850)-3/1(0810)	23.3	beige (1)	beige	beige	grey-brown	grey (m)
25	3/1(0845)-3/2(0800)	23.3	brown (1)	beige	beige	grey-brown	grey (m)
26	3/2(0830)-3/4(0750)	47.3	beige (1)	beige	beige	grey-brown	grey (m)
27	3/4(0820)-3/5(0800)	23.7	brown (1)	brown	brown	grey-brown	grey (m)
28	3/5(0830)-3/6(0810)	23.7	brown	brown	brown	brown	grey (m)

Leg III

Port	3/11(0900)-3/12(0810)	23.1	brown (h)	brown	brown	grey-brown	grey (h)
29	3/12(1315)-3/13(0840)	19.4	brown	brown	brown	grey-brown	grey (m)
30	3/13(0910)-3/14(0845)	23.6	brown (1)	brown	brown	brown	grey (m)
31	3/14(0915)-3/15(0840)	23.4	brown (1)	beige	beige	brown	grey (1)

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
32	3/15(0910)-3/16(0820)	23.2	brown (1)	beige	beige	brown	grey (1)
33	3/16(0855)-3/17(0835)	23.7	brown (1)	beige	beige	brown	grey (1)
34	3/17(0905)-3/18(0825)	23.3	brown (1)	beige	beige	brown	grey (1)
35	3/18(0855)-3/19(0810)	23.3	(barely viz)	beige (1)	beige (1)	brown	grey (1)
36	3/19(0910)-3/20(0815)	23.1	brown (1)	beige (1)	beige (1)	brown (1)	grey (v1)
37	3/20(0845)-3/21(0830)	23.8	brown (1)	beige (1)	beige (1)	brown (1)	grey (1)
38	3/21(0905)-3/22(0810)	23.1	brown (1)	beige (1)	beige (1)	brown (1)	grey (1)
39	3/22(0840)-3/23(0800)	23.3	brown (v1)	beige (v1)	beige (v1)	brown (v1)	grey (v1)
40	3/23(0820)-3/24(0840)	24.3	brown (v1)	beige (v1)	beige (v1)	beige (v1)	grey (v1)
41	3/24(0920)-3/25(0825)	23.1	brown (1)	grey-brown	grey	grey	grey (m)
42	3/25(0850)-3/27(0920)*	36.0	brown (1)	beige	beige	grey-brown	grey (m)
43-44	3/27(1610)-3/29(0830)	40.3	brown (v1)	beige	beige	brown	grey (m)
45-47	3/29(0900)-4/1(0800)*	70.3	brown (1)	beige	beige	brown	grey (1)
48-49	4/1(0810)-4/3(0810)*	47.8	brown (v1)	beige (1)	beige (1)	brown	grey (1)
50	4/3(0840)-4/4(1440)	30.0	brown (v1)	beige (1)	beige (1)	brown	grey (1)
51-52	4/13(1000)-4/15(1000)	47.8	brown	red-brown	red-brown	red-brown	grey (m)
53-54	4/15(1030)-4/17(1045)	48.0	brown	brown	red-brown	dark brown	grey (m)
55-56	4/17(1130)-4/19(1030)	46.8	dark brown	brown	brown	brown	grey (m)

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
57-58	4/19(1100)-4/21(1015)	47.0	dark brown	brown	brown	brown	grey (1)
59-60	4/21(1045)-4/23(0945)	46.8	brown (1)	brown (1)	brown (1)	grey-brown	grey (v1)
61-62	4/23(1030)-4/25(1015)	47.6	brown	red-brown	red-brown	brown	grey (1)
63-64	4/25(1100)-4/27(1015)	47.0	brown (1)	brown (1)	brown (1)	grey-brown	grey (m)
65-66	4/27(1045)-4/29(1015)	47.3	brown (v1)	brown (v1)	brown (v1)	grey (1)	grey (v1)
67-69	4/29(1045)-5/2(0815)	69.0	brown (1)	brown (1)	grey-brown	grey	grey (m)

Leg V

70-71	5/5(1915)-5/7(1245)	41.3	red-brown	red-brown	red-brown	red-brown	beige
72-73	5/7(1315)-5/9(1315)	47.8	red-brown	red-brown	red-brown	grey-brown	grey (m)
74	5/9(1530)-5/11(0200)	34.5	red-brown (1)	red-brown (1)	red-brown (1)	grey-brown (1)	grey (1)
75-76	5/11(0230)-5/13(0730)	52.8	red-brown	red-brown	red-brown	grey-brown	grey
77-78	5/13(0800)-5/15(1600)	55.8	red-brown	red-brown	brown	grey-brown	grey (m)
79	5/15(1630)-5/17(0730)	39.0	(barely viz)	(barely viz)	(barely viz)	grey (1)	grey (1)
80	5/17(0800)-5/18(2215)	38.3	grey (v1)	grey (v1)	grey (v1)	grey (1)	grey (v1)
81	5/18(2245)-5/20(1600)	41.3	(barely viz)	(barely viz)	(barely viz)	grey (1)	grey (v1)
82-83	5/20(1630)-5/22(1630)	47.8	(not viz)	(not viz)	(not viz)	grey (v1)	grey (1)
84	5/22(1700)-5/23(1040)	17.7	(not viz)	(not viz)	(not viz)	grey (v1)	grey (v1)

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
85	5/28(1300)-5/30(0500)	40.0	grey (m)	grey (m)	grey (m)	grey(m)	grey (h)
86	5/30(0530)-5/31(1915)	37.8	grey (m)	grey (m)	grey (m)	grey (h)	grey (h)
87	5/31(1945)-6/2(1200)	40.3	red-brown	grey (l)	grey (l)	grey (m)	grey (m)
88-89	6/2(1230)-6/4(1600)	51.3	red-brown	red-brown	red-brown	grey-brown	grey (l)
90-91	6/4(1630)-6/7(0330)	58.8	grey (vl)	grey (l)	grey (l)	grey (m)	grey (l)
92-93	6/7(0400)-6/9(?)		(not viz)	(not viz)	(not viz)	grey (vl)	grey (vl)
94-95	6/9(1815)-6/12(1615)	69.8	grey (l)	grey (l)	grey (l)	grey (h)	grey (m)
96-97	6/12(1700)-6/14(2315)	54.0	grey-brown(l)	grey-brown(l)	grey (l)	grey (l)	grey (l)
98-99	6/14(2340)-6/16(2245)	47.1	grey-brown(l)	grey (l)	grey (l)	grey (h)	grey (m)
100-101	6/16(2310)-6/18(0915)	34.0	grey-brown(l)	grey (l)	grey (l)	grey (h)	grey (h)
102	6/18(0945)-6/19(0200)	16.3	(barely viz)	(barely viz)	(not viz)	grey (vl)	grey (vl)

Leg VII

104	6/23(1330)-6/24(2030)	31.0	(not viz)	(not viz)	(not viz)	grey (vl)	grey (vl)
105	6/24(2050)-6/27(0000)	51.2	grey-brown	grey	grey	grey-black	grey-black
106	6/27(0030)-6/27(2000)	19.5	grey-brown	grey-brown	grey (l)	grey (l)	grey (l)
108	6/28(1100)-6/29(0915)	22.3	brown	grey-brown	grey (l)	grey (l)	grey (l)
109-110	6/30(0245)-7/2(0045)	45.0	(not viz)	(not viz)	grey (l)	grey (l)	grey (l)

Exposure No.	Dates-Times	Cum. Hrs.	Filter Color				
			<u>P1</u>	<u>P2</u>	<u>P3</u>	<u>P4</u>	<u>GF</u>
111-112	7/2(0100)-7/4(0000)	47.0	grey-brown(v1)	grey-brown	grey (1)	grey (1)	grey (1)
113	7/4(0030)-7/5(0900)	32.5	grey (v1)	grey (v1)	grey (1)	grey (1)	grey (1)
114-116	7/6(0120)-7/7(2250)	44.8	grey (v1)	grey (v1)	grey (v1)	grey (1)	grey (1)

APPENDIX II

Airborne Particulate Sampling Program

High-Volume Air Sampler Results: Filter Color

R/V ATLANTIS II

Legs I through VII

Jan. 20, 1973 to July 7, 1973

Leg I

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum. Hrs.</u>	<u>Filter Color</u>
1	1/25(1300)-1/27(1300)	48.0	grey (barely viz)
2	1/27(2100)-1/29(1415)	41.3	beige-orange (v1)
3	1/29(2115)-1/31(1300)	39.8	beige
4	1/31(1830)-2/1(1900)	24.5	grey-brown
5	2/1(1930)-2/3(1445)	43.3	grey-brown
6	2/3(1515)-2/4(1545)	24.5	grey (barely viz)
7	2/4(1945)-2/6(1200)	41.8	grey-brown
8	2/6(1215)-2/7(1000)	21.8	grey (1)

Leg II

9	2/11(0830)-2/12(0945)	25.3	grey-brown
10	2/12(1150)-2/13(0930)	21.7	grey-brown
11	2/13(1445)-2/15(0950)	36.4	grey
12	2/15(1650)-2/17(0830)	31.7	brown
13	2/17(0900)-2/18(0815)	23.8	grey-brown
14	2/18(0900)-2/19(0810)	23.8	grey-brown
15	2/19(0845)-2/20(0800)	23.3	grey-brown
16	2/20(0835)-2/21(0830)	24.0	grey-brown
17	2/21(0900)-2/22(0810)	23.1	grey-brown
18	2/22(0850)-2/23(0810)	23.3	grey-brown

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum Hrs.</u>	<u>Filter Color</u>
19	2/23(0840)-2/24(0800)	23.3	grey-brown
20	2/24(0900)-2/25(0820)	23.3	grey-brown
21	2/25(0900)-2/26(0820)	23.3	grey-brown
22	2/26(0930)-2/27(0800)	22.5	grey
23	2/27(0830)-2/28(0815)	23.8	grey
24	2/28(0850)-3/1(0810)	23.3	grey
25	3/1(0845)-3/2(0800)	23.3	grey-brown
26	3/2(0830)-3/4(0750)	47.3	grey
27	3/4(0820)-3/5(0800)	23.7	grey
28	3/5(0830)-3/6(0810)	23.7	brown (h)

Leg III

29	3/12(1315)-3/13(0840)	19.4	brown (h)
30	3/13(0910)-3/14(0845)	23.6	brown (h)
31	3/14(0840)-3/15(0840)	23.4	brown (m)
32	3/15(0910)-3/16(0820)	23.2	brown (m)
33	3/16(0855)-3/17(0835)	23.7	brown (m)
34	3/17(0905)-3/18(0825)	23.3	brown
35	3/18(0810)-3/19(0810)	23.3	grey-brown (vl) (motor burn out)
36	3/19(0815)-3/20(0815)	23.1	grey-brown
37	3/20(0845)-3/21(0830)	23.8	brown (l)
38	3/21(0905)-3/22(0810)	23.1	grey-brown (l)
39	3/22(0840)-3/23(0800)	23.3	grey-brown (vl)

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum. Hrs.</u>	<u>Filter Color</u>
40	3/23(0820)-3/24(0840)	24.3	grey-brown (v1)
41	3/24(0920)-3/25(0825)	23.1	grey
42	3/25(0850)-3/27(0920)	37.0	grey-brown (1)
43	3/27(1610)-3/28(0820)	16.1	grey-brown (1)
44	3/28(0830)-3/29(0830)	24.0	grey-brown (1)
45	3/29(0900)-3/30(0830)	23.5	grey-brown (1)
46	3/30(0845)-3/31(0800)	23.3	grey-brown (1)
47	3/31(0830)-4/1(0800)	23.5	(barely viz)
48	4/1(0830)-4/2(0810)	23.7	(barely viz)
49	4/2(0820)-4/3(0810)	23.8	grey-brown (v1)
50	4/3(0840)-4/4(1440)	30.0	brown (1)

Leg IV

51	4/13(1000)-4/14(0930)	23.5	beige-brown
52	4/14(0945)-4/15(1000)	24.3	beige-brown
53	4/15(1030)-4/16(0945)	23.3	beige
54	4/16(1000)-4/17(1045)	24.8	beige
55	4/17(1130)-4/18(0945)	22.3	beige-brown
56	4/18(1000)-4/19(1030)	24.5	beige-brown
57	4/19(1100)-4/20(1100)	24.0	beige-brown
58	4/20(1115)-4/21(1015)	23.0	beige-grey
59	4/21(1045)-4/22(1015)	23.5	grey (1)
60	4/22(1030)-4/23(0945)	23.3	grey (1)

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum. Hrs.</u>	<u>Filter Color</u>
61	4/23(1030)-4/24(1000)	23.5	beige
62	4/24(1010)-4/25(1015)	24.1	beige (1)
63	4/25(1100)-4/26(1015)	23.3	grey-brown
64	4/26(1030)-4/27(1015)	23.8	grey (1)
65	4/27(1045)-4/28(1015)	23.5	grey (v1)
66	4/28(1030)-4/29(1015)	23.8	grey (1)
67	4/29(1045)-4/30(1015)	23.5	grey (1)
68	4/30(1030)-5/1(1015)	23.8	grey (1)
69	5/1(1030)-5/2(0815)	21.8	grey (m)

Leg V

70	5/5(1915)-5/6(1245)	17.5	red-brown (h)
71	5/6(1300)-5/7(1245)	23.8	red-brown (h)
72	5/7(1315)-5/8(1245)	23.5	red-brown (m)
73	5/8(1300)-5/9(1315)	24.3	grey (m)
74	5/9(1530)-5/11(0200)	34.5	grey-beige
75	5/11(0230)-5/11(1845)	16.3	grey (1)
76	5/11(1900)-5/13(0730)	36.5	grey-brown
77	5/13(0800)-5/14(0715)	23.3	beige
78	5/14(0730)-5/15(1600)	32.5	grey-brown
79	5/15(1630)-5/17(0730)	39.0	grey (1)
80	5/17(0800)-5/18(2215)	38.3	grey (1)
81	5/18(2245)-5/20(1600)	41.3	grey (1)

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum. Hrs.</u>	<u>Filter Color</u>
82	5/20(1630)-5/21(1800)	25.5	grey (1)
83	5/21(1815)-5/22(1630)	22.3	grey (v1)
84	5/22(1700)-5/23(1040)	17.7	grey (v1)

Leg VI

85	5/28(1300Z)-5/30(0500)	40.0	dark grey
86	5/30(0530)-5/31(1915)	37.8	dark grey
87	5/31(1945)-6/2(1200Z)	40.3	grey-brown
88	6/2(1230)-6/3(1800)	29.5	grey-brown
89	6/3(1815)-6/4(1600)	21.8	grey (1)
90	6/4(1630)-6/6(0830)	40.0	grey (v1)
91	6/6(0845)-6/7(0330)	18.8	grey (v1)
92	6/7(0400)-6/8(1345)	23.8	grey (m)
93	6/8(1645)-6/9(1645)	24.0	grey (m)
94	6/9(1715)-6/11(0330)	34.3	grey (v1)
95	6/11(0345)-6/12(1615)	36.5	grey (v1)
96	6/12(1700)-6/13(1615)	23.3	grey-brown (1)
97	6/13(1630)-6/14(2315)	30.8	grey (1)
98	6/14(2340)-6/15(2330)	23.8	grey (h)
99	6/15(2345)-6/16(2245)	23.0	grey (m)
100	6/16(2310)-6/17(1645)	17.6	grey (h)
101	6/17(1650)-6/18(0915)	16.4	grey (1)
102	6/18(0945)-6/19(0200)	16.3	grey (1)

<u>Exposure No.</u>	<u>Dates-Times</u>	<u>Cum. Hrs.</u>	<u>Filter Color</u>
103	6/19(0215)-6/19(0850)	6.6	grey (l)
<u>Leg VII</u>			
104	6/23(1330)-6/24(2030)	31.0	grey (l)
105	6/24(2050)-6/27(0000)	51.2	black (h)
106	6/27(0030)-6/27(2000)	19.5	grey (m)
107	6/27(2015)-6/28(1050)	14.6	grey (h)
108	6/28(1100)-6/29(0915)	22.3	grey (m)
109	6/29(0930)-6/30(0215)	16.8	grey (m)
110	6/30(0245)-7/2(0045)	45.0	grey (m)
111	7/2(0100)-7/2(1930)	18.5	grey (l)
112	7/2(1945)-7/3(?)		(not viz)
113	7/4(0030)-7.5(0900)	32.5	grey (l)
114	7/6(0130)-7/7(0000)	22.5	grey (vl)
115	7/7(0015)-7/7(1215)	12.0	grey (vl)
116	7/7(1230)-7.7(2250)	10.3	grey (vl)